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SUPPLEMENT TO "A STUDY ON DESIGN AND COST ANALYSIS OF A PROTOTYPE COAL CLEANING PLANT"

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Four alternate methods suggested in the report which this one supplements are explained in detail. The most economical method to determine the reduction of sulphur from a given raw coal is based on beneficiation equipment currently used by coal washing contractors; it involves extensive laboratory testing from suitable raw coal samples. If carried out in one of the existing government laboratories it would involve no capital investment; operating costs would also be small. In case a plant is desired to demonstrate in actual practice the reduction of sulfur as well as to generate data for a given coal, it will be of substantial value both from a scientific and commercial standpoint to build a full scale commercial plant. Being capable of operation at a full commercial rate, this facility would be able to provide an adequate return on the total investment. It would be an added advantage if cooperation could be obtained from a large coal company to run the plant.

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SUPPLEMENT TO
"A STUDY ON DESIGN AND COST ANALYSIS OF A PROTOTYPE COAL CLEANING PLANT"

November 1969

A Report To

PROCESS CONTROL ENGINEERING DIVISION

NATIONAL AIR POLLUTION
CONTROL ADMINISTRATION

U. S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE

CONTRACT NO. PH 22-68-59

OBJECT

The purpose of this supplementary report is to explain in detail the alternate methods suggested in our report entitled "A Study on Design and Cost Analysis of a Prototype Coal Cleaning Plant". Four different alternates were suggested and these will be explained in the order listed in the above "STUDY".

ALTERNATE METHODS

I. Under Part VI of the "STUDY", #1, on Pages 70 and 71, the first alternate is outlined in detail. As indicated, from our investigation and cost analysis carried out in our "STUDY", we felt that some consideration should be given to the construction of a full scale commercial plant primarily because the capital investment will be much more effectively used in building the larger plant. The laboratory costs would be approximately the same in both the cases, i.e., a 50 TPH prototype plant and a full scale commercial plant of say 1000 TPH.

If a 50 TPH capacity prototype plant is built, it will only serve the purpose of generating data and demonstrating in actual practice reduction of sulfur for a given coal and such a plant will have practically no commercial value. But if a full scale commercial plant with parallel test circuits, where necessary, is constructed, it will be of substantial value both from the scientific as well as commercial standpoint. From a cost standpoint, administrative office and laboratory personnel would be at about the same level for either a test or a commercial size plant.

For the purpose of cost comparison between a full scale commercial plant of 1000 TPH and a 50 TPH prototype plant, an estimated operating cost, including operating and maintenance labor, spare

parts and supplies, power, amortization and insurance, is taken as $0.55 per ton of washed coal. As the actual operating cost of a full scale plant varies depending on the location, type of operation and type of equipment used, this figure ($0.55/ton) is not to be taken as a standard.

In making a scientific study to generate data on the reduction of sulfur for a given coal, a fully equipped laboratory will have to be installed with the plant, unless a central laboratory is located near the plant and its facilities are available for testing purposes. In this instance, we shall consider that a separate laboratory will be built with the plant.

The revised capital cost including the start-up of the laboratory for the 1000 TPH plant will be approximately $2,050,000. Additional labor and supplies will be required to handle the testing of the increased number of samples required for the 1000 TPH plant. The estimated operating costs would be approximately $2,350,000 per annum.

On the basis of washing 1000 tons per hour, 15 hours a day, and 22 days a month, 3,960,000 tons, say 3,500,000 tons of coal will be processed per year.

Operating cost of the laboratory including labor, supplies, utilities, etc., is $2,350,000/3,500,000	-	$0.67/ton
Amoritization of capital investment of $2,050,000 for 20 years and insurance cost	-	$0.04/ton
		$0.71/ton

Therefore, the total operating cost per ton of output to run a full scale commercial plant and the laboratory would be $.55 + $.71, or $1.26. This compares to $35.50 per ton of raw coal washed in a 50 TPH prototype plant, not including the costs of the raw coal

and sales expense involved in disposing of the washed coal.

Although the cost of the operation of the plant and the laboratory is high when compared to a commercial plant, it is much cheaper than the operating cost of a 50 TPH prototype plant. The high operating cost in both cases is due to the high capital investment and high operating costs of the fully equipped laboratory attached to the plant. (Capital and operating cost of the laboratory would be reduced considerably if the testing work could be done in an existing central laboratory, which will be discussed under II).

Assume that the average cost of raw coal is $4.50/ton. At an assumed 80% recovery of washed coal, the cost of washed coal would be $4.50/.8 or $5.63/ton plus the above washing cost of $1.26/ton; this would total $6.89/ton of washed coal. (This does not include the raw coal and washed coal transportation costs and does not take into account any credit due from the sale of washed coal or pyrite produced). At the prevalent price, washed coal with less than 1.0% total sulfur would sell for $6.45/ton. The plant will, therefore, run at a loss of $6.89 - $6.45, or $0.44/ton; however, such a loss would be expected due to the extreme amount of testing required for the generation of scientific data, which is not done by plants run strictly on a commercial basis. These approximate cost estimates illustrate the value of being able to use the 1000 TPH plant capacity. On the other hand, the above estimated costs are only an indication since the operation of the 50 TPH test circuit would be at a great sacrifice in cost, since the 1000 TPH capacity could not be utilized while tests were being conducted. On the other hand, careful scheduling would make it possible to run most of the 50 TPH tests on an off-shift, to take better advantage of the overall capital investment.

As indicated in the "STUDY", close cooperation with a large coal company would probably be necessary to assure that the suggested alternative would become a financial success; or the 1000 TPH

capacity plant could be run as a cooperative venture by a group of coal companies through the National Coal Association or the Bituminous Coal Research.

II. Under Part VI of the "STUDY", Page 72, the second alternate is outlined in detail. As indicated, since major contributions to both capital and operating costs are the laboratory and testing facilities and procedures, some consideration should be given to the use of existing central testing laboratories (with expanded facilities and manpower, if necessary), rather than to have to build all of the extensive facilities which were contemplated in the "STUDY".

If the preparation plant is located near an existing central testing laboratory which could by some alteration meet the testing requirement of the plant, it would not be necessary to build a separate laboratory facility with the plant. Even if the plant is not located near an existing central testing laboratory, a control laboratory with limited facilities could be built with the plant. In the control laboratory, quick analysis for the purpose of controlling the equipment or a circuit or the entire plant could be made. The samples, for routine analysis of the products or other analysis to generate scientific data, would be forwarded to a central laboratory.

In case a laboratory is not built with the test plant, or only a control laboratory with limited facilities is built with the plant, the laboratory costs and consequently the capital and operating cost of the plant would be reduced considerably.

III. Under Part VI of the "STUDY", #3, on Page 72, the third alternate is outlined in detail. As indicated, another approach would be to seek cooperation from various coal operators to use their cleaning plants which are strategically located in relation to the sources of the coals to be tested; arrangements would have to be made to add temporary modifications to the plant in question

both by adding the necessary extra processing equipment and any necessary sampling equipment to assure the use of the cleaning methods and the collection of samples of the coals at desired points in the plant. The necessary samples could be collected under the supervision of the plant personnel and tested in the plant laboratory, if available, or at the nearest available suitable testing laboratory.

Such an arrangement would involve a comparatively small capital investment for plant modification and additional processing equipment for the test circuits. The few additional personnel needed to handle the operation and testing would greatly reduce the operating costs.

IV. Under Part VI of the "STUDY", #4, on Pages 72 and 73, the fourth alternate is outlined in detail. As indicated, experienced coal washing contractors are able to predict accurately ash, moisture and sulfur levels in washed coal, provided washability data is available on reliable samples of the coal to be washed. This capability is based on the use of benificiation equipment currently in use in the industry.

Generation of accurate results depends upon the reliability of the samples of the coal to be processed; in other words, is the sample a representative one? It is not necessary for us to detail the methods of sampling or for conducting the various washability and laboratory tests to generate data for the prediction of results. Samples for the washability tests, however, should be collected on the basis of ASTM Standards D2234-68.

The raw coal crushed to the required size is subjected to float and sink tests and chemical analyses from which data is generated for the prediction of the results shown below. To illustrate the prediction of washing results, we shall use the coal from Ohio No. 6 seam shown in Table 1. Since crushing 1-1/2" x 0

raw coal to 3/8" top size shows liberation of pyrite, the 3/8" x 100M and 3/8" x 1/2mm washability studies will be used for illustration.

Table 1 shows the theoretical recovery of coal at various specific gravities and the total sulfur content for each cumulative gravity fraction. Tables 1 and 2 show the analysis of 3/8" x 100M and 3/8" x 28M Ohio No. 6 seam raw coal respectively. The two sizes of raw coal are considered for the predictions of results when cleaning in a heavy media cycloid, and a McNally Visman Tricone (single stage and two stage respectively). The predicted results, i.e., the recovery and total sulfur of washed coals at different specific gravities is given in Table 2. The difference between the theoretical and actual results, is due to the raw coal characteristics and the efficiency of the equipment in which a coal of a given size consist is to be washed.

The cumulative float total sulfur curves shown in the figures 1,2 and 3 illustrate the predicted washed coal recovery and total sulfur content at different separating gravities, when 3/8" x 28M and 3/8" x 100M fractions of Ohio No. 6 seam raw coal are washed in a H.M. cycloid and McNally-Visman Tricone (single and two stage) respectively.

To meet the requirement of air pollution regulations in various states, coals with different sulfur levels will be recommended for burning by the state authorities. Once the sulfur level is known, the actual recovery of washed coal and the separating gravity can be determined from the two curves shown in each of these three figures. For example, if the total sulfur requirement is 1.0%, the yield of washed coal will be about 90.3% when 3/8" x 28M raw coal from the Ohio No. 6 seam is washed in a H.M. cycloid at a specific gravity 1.64. Similarly, the yield of washed coal containing 1.0% total sulfur will be about 88.2% when washed in a

single stage McNally-Visman Tricone at a specific gravity of 1.64, and an 89.5% yield of washed coal when washed in two stage McNally-Visman Tricones at a specific gravity of 1.64. The difference in the theoretical recovery and predicted recovery of washed coals for given sulfur levels can be seen in the Tables 1 and 2.

CONCLUSION

From the foregoing, we conclude that the most economical method to determine the reduction of sulfur from a given raw coal would be as outlined under IV, which involves extensive laboratory testing from suitable raw coal samples. From the data generated through these laboratory tests the recovery of the washed coal at different sulfur levels can be accurately predicted. This method would involve no capital investment if carried out in one of the existing government laboratories; operating costs would also be small.

In case a plant is desired to demonstrate in actual practice the reduction of sulfur as well as to generate data for a given coal, it will be of substantial value both from a scientific and commercial standpoint to build a full scale commercial plant. Being capable of operation at a full commercial rate, this facility would be able to provide an adequate return on the total investment. It would be an added advantage if cooperation could be obtained from a large coal company to run the plant.

TABLE 1

Theoretical Recovery of Washed Coal and Total Sulfur Level

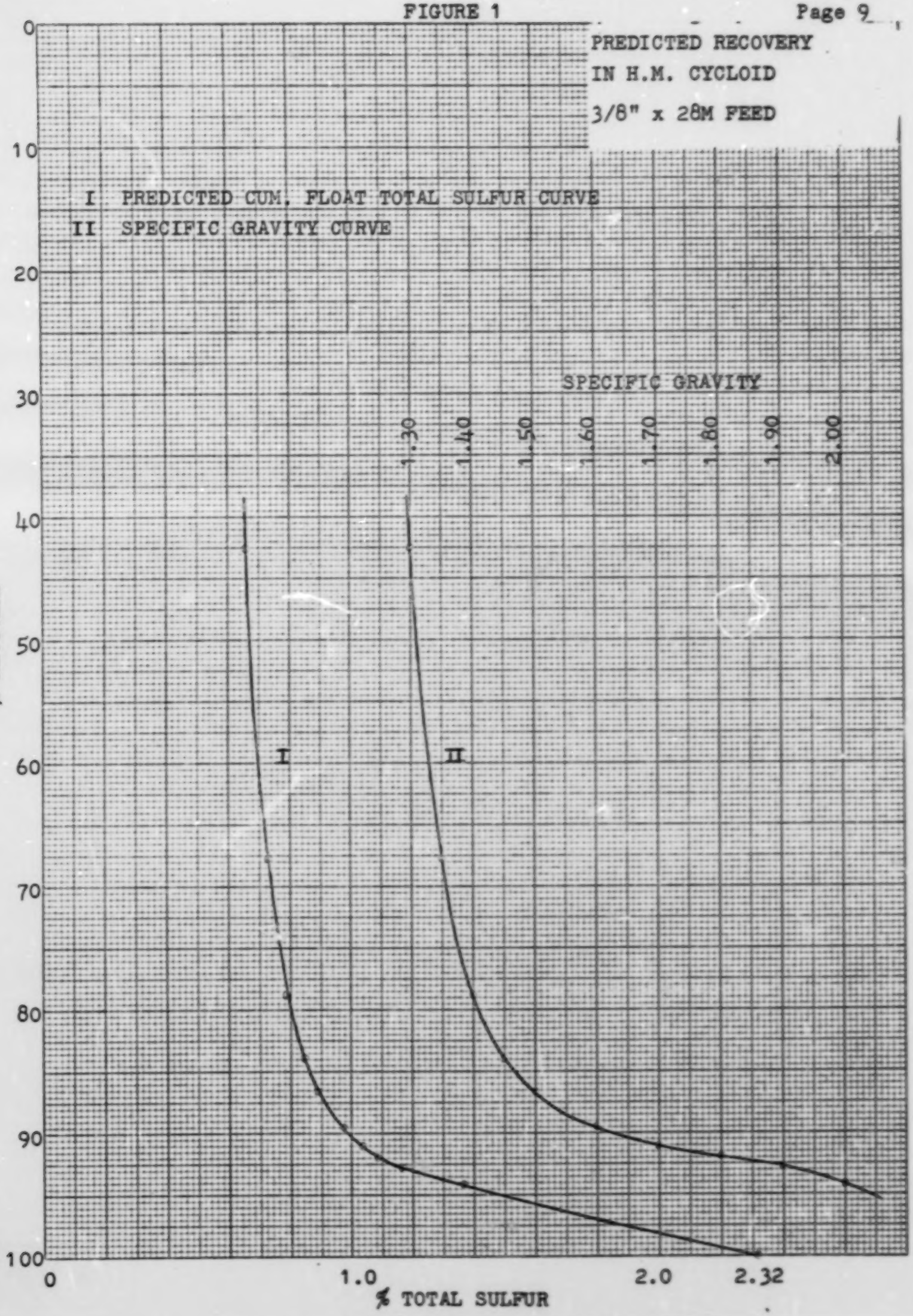
Sp. Gr.	3/8" x 28M Cumulative % Wt.	3/8" x 28M Cumulative % Total Sulfur	3/8" x 100M Cumulative % Wt.	3/8" x 100M Cumulative % Total Sulfur
1.30	50.77	0.62	51.14	0.62
1.35	73.20	0.72	73.23	0.72
1.40	81.51	0.79	81.46	0.79
1.45	85.41	0.85	85.33	0.85
1.50	87.43	0.89	87.37	0.89
1.60	89.82	0.98	89.78	0.98
1.70	91.35	1.05	91.30	1.04
1.80	91.97	1.09	91.92	1.08
1.90	92.61	1.14	92.56	1.13
2.00	93.15	1.19	93.11	1.18
	100.00	2.32	100.00	2.31

TABLE 2

Predicted Recovery of Washed Coal and its Total Sulfur Level

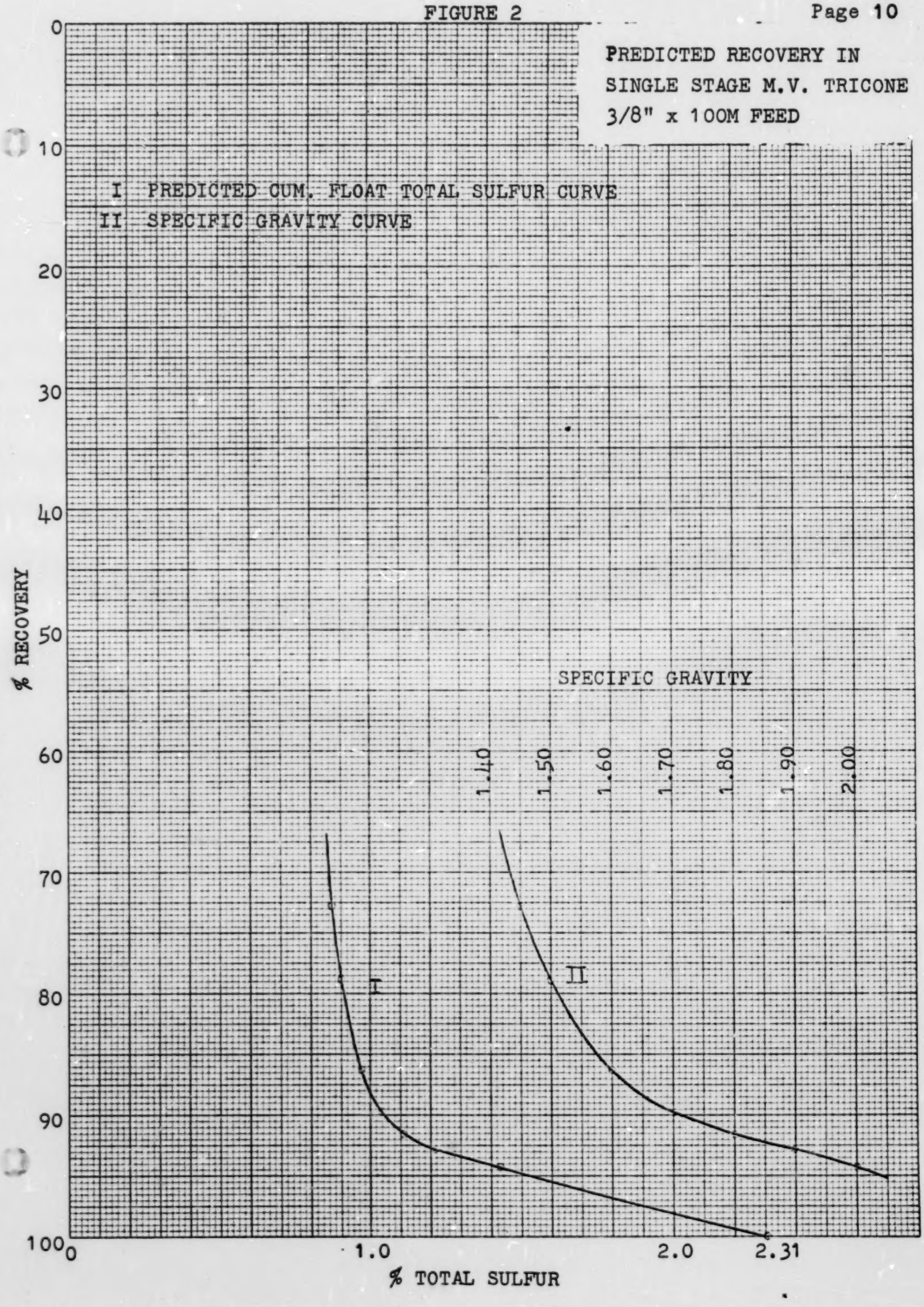
Sp. Gr.	H.M. Cyclone (3/8" x 28M) % Wt.	H.M. Cyclone (3/8" x 28M) %Total Sulfur	Single State M.V. Tricone (3/8" x 100M) % Wt.	Single State M.V. Tricone (3/8" x 100M) % Total Sulfur	Two Stage M.V. Tricone (3/8" x 100M) % Wt.	Two Stage M.V. Tricone (3/8" x 100M) % Total Sulfur
1.30	42.51	0.66	---	----	-----	----
1.35	67.67	0.73	---	----	-----	----
1.40	78.77	0.79	---	----	-----	----
1.45	83.92	0.85	72.75	0.87	77.09	0.85
1.50	86.57	0.89	78.88	0.90	82.63	0.89
1.60	89.48	0.98	86.22	0.97	88.24	0.97
1.70	91.03	1.04	89.72	1.04	90.61	1.03
1.80	91.92	1.09	91.54	1.11	91.80	1.09
1.90	92.72	1.17	92.83	1.22	92.72	1.18
2.00	94.08	1.37	94.33	1.43	94.03	1.36
	100.00	2.32	100.00	2.31	100.00	2.31

FIGURE 1



EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

FIGURE 2



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